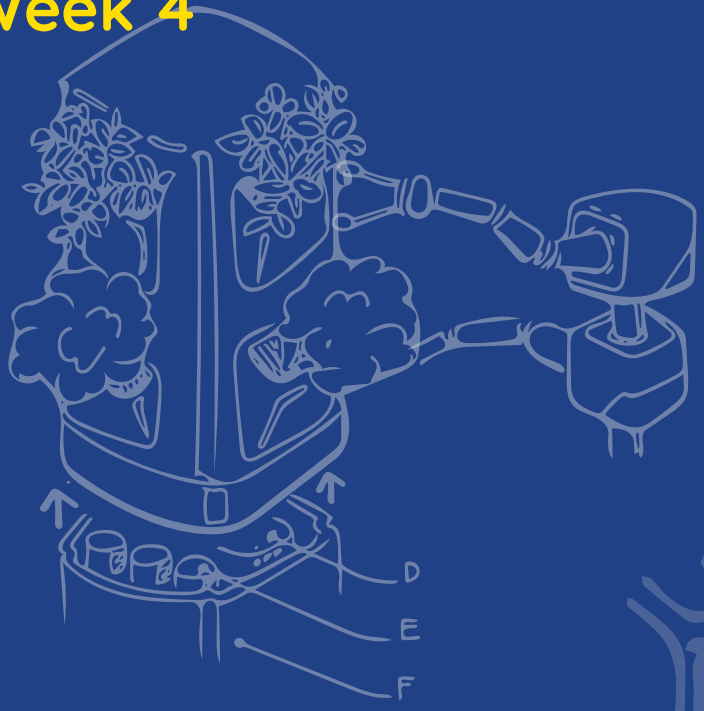
Name:

ENGINEERING DESIGN FOLIO

The Australian Virtual Astronaut Challenge

Week 4



SISP
STEM Industry School Partnerships

Splat® 3D
Think. Draw. Design.

v 1

Design Drawings

Activity: Draw a top view and a either a side or front view of your design idea or experiment apparatus.

Sketching a front and top view.

What is Design?
A design is a plan or specification for the construction of an object or system. The result of that plan or specification can be in the form of a prototype, product or process.

The design usually has to satisfy certain goals and constraints, may take into account aesthetic, functional, or economic considerations, and is expected to interact with a certain environment. Major examples of designs include architectural blueprints, engineering drawings, detail drawings, concept drawings as well as sketches, renderings or artist impressions.

Design Drawings
Design drawings are typically aesthetic drawings or renderings that represent possible solutions. Drawings are typically the first step in the design phase.

Design Activities
In some cases, constructing an object first, without plans may also be considered to be a design activity.

TOP VIEW

FRONT/SIDE VIEW

Design

Activity: Pictorial views

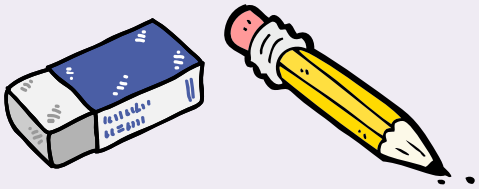
Practise sketching one small part of your design as a pictorial view. Alternatively, sketch any object that travels into space.

Sketching pictorial drawings at www.iteachstem.com.au

Bottle rockets drawn using a template.

ISOMETRIC VIEW

Design Drawings



Rendering

Rendering is the process of creating the effects of light, shade and light source to achieve contrast in drawings. rendering improves the quality of line drawings. while line drawing indicate more of the shape than the form of an object drawn, rendering improves the quality of the drawing so as to give it a photo- realistic quality.

Colouring vs Rendering

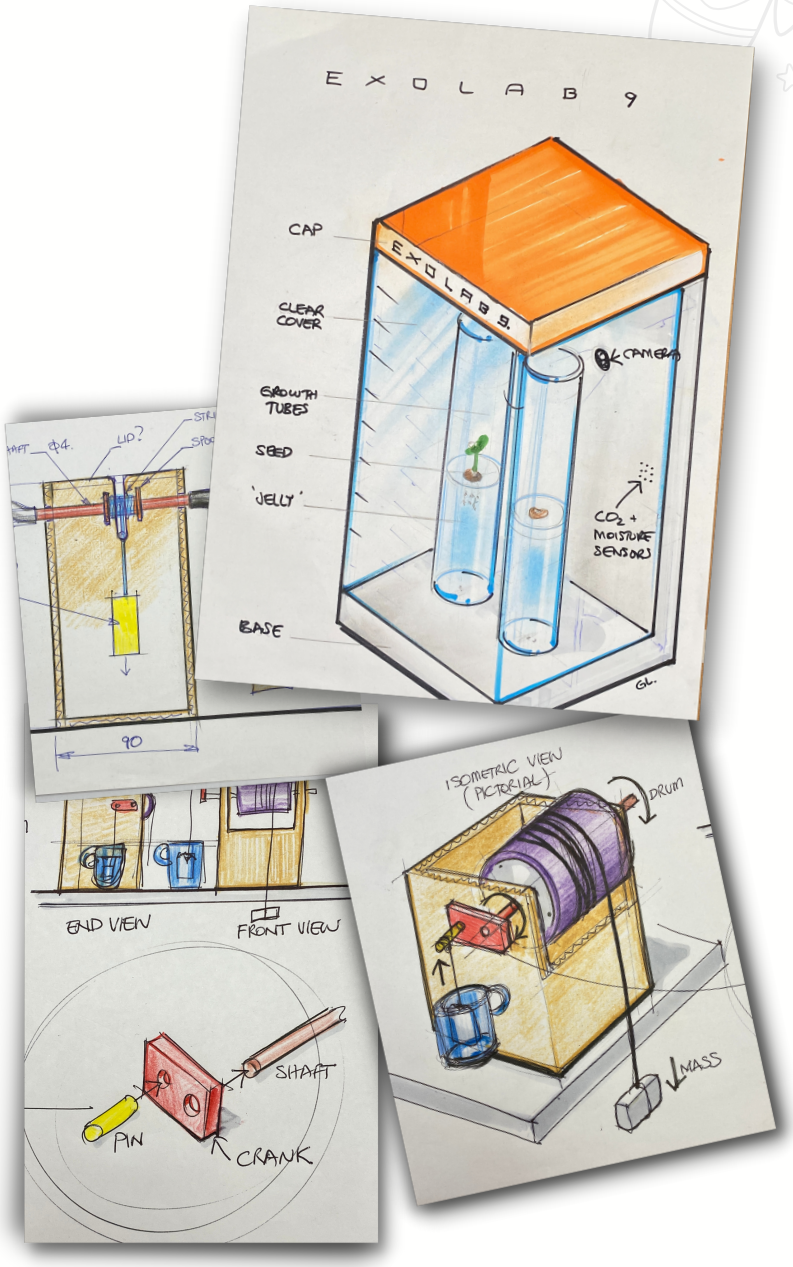
Colouring = Coloured "in the lines", or put colour in the areas they belong.

Rendering = Making the image really pop, by adding shading and details so it looks more polished and professional.

Annotations

Annotations are brief, written explanations provided with design deliverables in order to define & describe aspects of the design.

Watch the video by Splat 3D on how to produce annotated and rendered drawings such as those to the right/top.



Above: Design drawings for mechanical devices.

Below: Click on any of the five core 3D objects for a demonstration of how to render them.

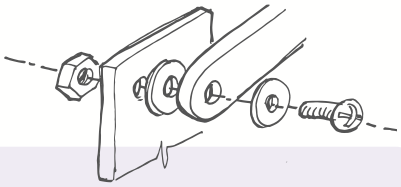
Design

Activity: Using the isometric grid below try drawing/sketching a more detailed example of your design. Include some measurements.

Annotate your design using notes with arrows. Explain the highlights of your design.

Identify the materials in your design.

Design Drawings



Activity: Bring all your design ideas into one final design drawing or blueprint for your experiment, device or environment. This does not need to be a fantastic drawing, it just helps to get to the next stage in the iSTEM process - prototyping. It is a good idea to base your drawing on the materials, parts or lab equipment that you know will be available to use while constructing your prototype.

Prototype

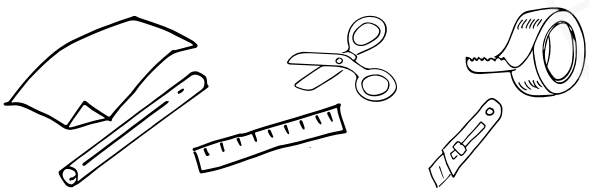
A prototype is where you construct a physical example of your design.

Constructing a prototype

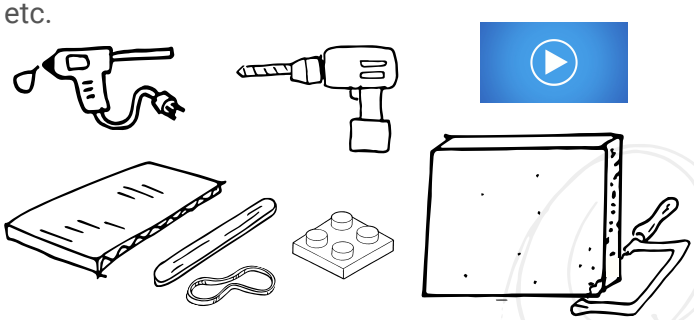
Prototypes are for validating a design or a hypothesis. A prototype is used for testing whether the design will work as expected or not. Usually new insights are gained once the engineers and scientists get to experiment with the physical product.
Prototypes are for learning, so it is a good idea to keep them as simple as possible.

Different kinds of prototypes

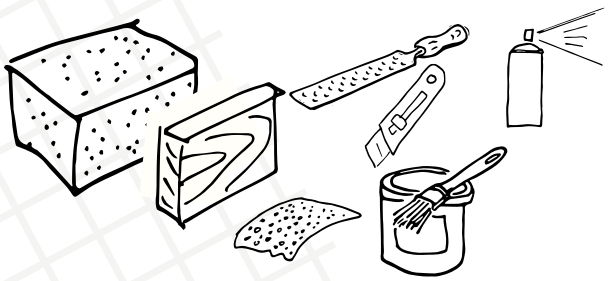
1. **Paper prototypes** - 'thinking in paper' are super quick to make and help us to visualise our ideas, especially those that are hard to sketch . They are most often used in the early stages of design. Typical materials include;



2. **Rough prototype** - a proof of concept is a working prototype that proves a device or system works. It does not need to look like your final design, and will be constructed as quickly as possible. Sometimes just one part of your design is prototyped to demonstrate it works. This rough build is sometimes called a 'mock-up'.
Materials may include MDF sheet, Coreflute panel, corrugated cardboard, hot glue, acrylic, aluminium rod, screws, nuts and bolts, plastic bricks, elastic bands, springs, microcontroller, motors, sensors etc.



3. **Appearance prototype** - a static model is used to show the final look and feel of a design, especially for products that must have visual (aesthetic) appeal. 3D printed parts are often smoothed and painted for this purpose.
Materials may include balsa wood, plaster, blue foam, styrofoam, wood, undercoat/sealer and brush, spray paint, abrasive paper etc



4. **Engineering prototype** - is a working example of a design but also has the appearance, size and the same materials found in the design/blueprint. This type of prototype can be very expensive to make because it requires specialist knowledge and equipment.

Prototype

A prototype is where you construct a physical example of your design.

Activity: Attach photographs of your prototype to this page and, if possible, a link to a video of your prototype in action.

Activity: Outline the steps in the construction of your prototype and describe at least two obstacles encountered in the process.

Design - Computer Aided Design

Computer Aided Design (CAD)
Computer aided design uses computers to design products.

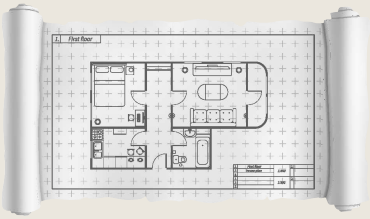
CAD allows designers to draw objects accurately. The accuracy of CAD drawings is made possible by coordinates which are used to locate and define points. CAD drawings can be two-dimensional (2D) or three-dimensional (3D).

2D CAD programs
In 2D CAD drawings, coordinates are represented as (x,y) coordinates.

Examples of 2D CAD software programs include: 2D Design, AutoCAD LT, Illustrator, Paint and many more.

3D CAD programs
In 3D CAD drawings coordinates are represented by (x, y and z) coordinates.

Examples of 3D CAD software programs include: TINKERCAD, Google SketchUp, Fusion 360, Onshape, Solidworks, Creo, Solid Edge and CATIA. Many of these titles can be obtained free for staff and student use.



Cloud Based CAD and Collaboration
The advent of Cloud based CAD has enabled enhanced collaboration as teams can work on projects remotely with access to the latest version of the software from a multitude of devices. This is possible in a school environment with titles such as TINKERCAD and Fusion360.
Cloud based CAD has led to improved productivity, COLLABORATION and a more flexible work environment.

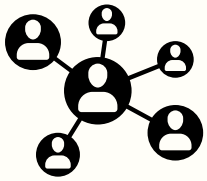
TINKERCAD
TINKERCAD is a free online 3D design app from Autodesk geared towards complete beginners. It is used all over the world to help people think, create and make. TINKERCAD is used extensively by students in middle school years. The software features an intuitive block-building concept, allowing designers to develop models from a set of basic shapes. TINKERCAD allows users to place, adjust and combine shapes to create custom and intricate solutions.

TINKERCAD has a wide range of free online tutorials to guide users through the skills required to 'Tinker'. TINKERCAD also has a facility called TINKERCAD Classrooms. TINKERCAD Classrooms is a tool teachers can use to quickly get students up and running with TINKERCAD. Once students sign on with a class code the teacher provides, the teacher can view and manage student progress in TINKERCAD from a convenient dashboard.

Link to TINKERCAD classrooms: https://blog.tinkercad.com/official-guide-to-tinkercad-classrooms
Link to TINKERCAD projects (there is a build your own space station): https://www.tinkercad.com/learn/project-gallery;collectionId=0Y5L5E8IRXTI47Z

Collaboration in TINKERCAD

TINKERCAD allows you to actually have multiple people working on the design at the same time.

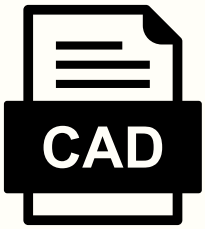


Design - Computer Aided Design

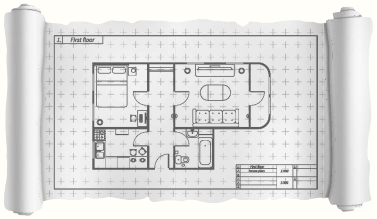
SketchUp Pro 2021

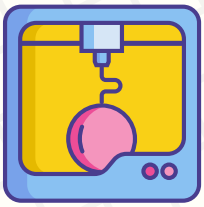
SketchUp is easy to use and can be learned fairly quickly, especially in comparison with other 3D CAD programs. The program comes in several variants. SketchUp for Schools is browser-based for Primary and Secondary schools signed up with G Suite for Education or Microsoft Education. SketchUp Pro is a full featured 3D modelling tool. All SketchUp variants allow the designer to 3D model and iterate in 3D space.

FUSION 360:
Fusion 360 is a cloud-based 3D CAD program. It's unique in the sense that it uses the power of the could to bring together design teams to collaborate on complex projects. An advantage of the Fusion 360° platform is it stores the entire history of the model including all the changes. It contains numerous design options, including freeform, solid and mesh modelling. It runs on multiple platforms and allows users to access their information wherever they want.



Activity:
Using a CAD package of your choice, produce a simple 3D design. This could be a moon digging robot, habitat dome, experimental apparatus, space station or just part of your project. Print it out and stick it in the space below.





Computer Aided Manufacturing (CAM)
Once an object is designed in a 3D CAD program it can then be saved/exported in a file format suitable (eg: .STL) for Computer Aided Manufacture (CAM). CAM includes 3D printers, CNC Mills and Laser Engravers.

Make a Lung Model

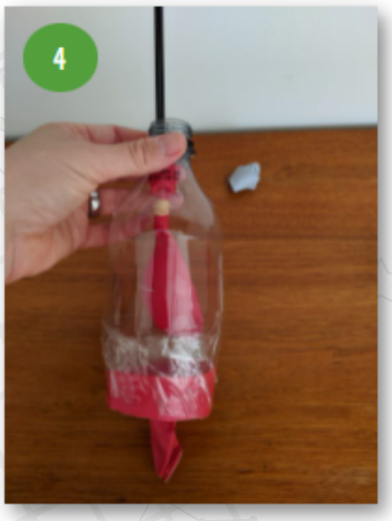
You will need:

- A clean dry plastic bottle
  (around 600mL works well but other sizes are OK too)
- Two balloons
- A straw
- Scissors
- Sticky tape, masking tape or electrical tape
- A rubber band
- Blu-tack, modelling clay, plasticine or firm playdough

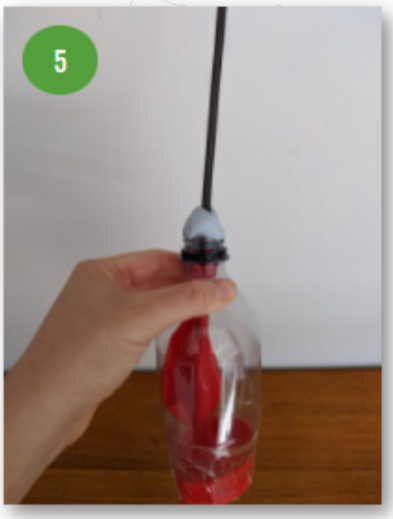
Carefully cut the bottom off the plastic bottle and cut the top (the round part) off one of the balloons.

Stretch the cut part of the balloon over the bottom of the bottle like the skin on a drum, with the neck of the balloon hanging free. Secure with tape.

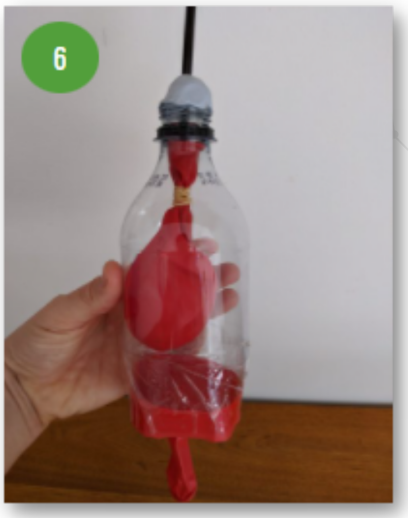
Put the straw inside the other balloon and attach securely using the rubber band.
Note: Avoid crushing the straw with an overly tight rubber band.



Put the balloon inside the bottle. It should be hanging free and not touching the other balloon. This hanging balloon represents the lung.



Hold the straw in place using the blu-tack (or similar) to create a lid. Ensure the entire neck of the bottle is covered to make an air-tight seal.



Your lung model is ready to use!

Click here for more info

Train Like an Astronaut

Let's get active!

Your Mission: Building An Astronaut 'Core'
You will perform the Commander Crunch and Pilot Plank to improve the strength in the abdominal and back muscles. As you train like an astronaut, record your observations about improvements in core muscle strength during this physical experience

MISSION QUESTION: How can you perform a physical activity that will improve abdominal and back muscles?

Mission Assignment: Core Strength Training
You will do the following activities with a partner. A warm-up/stretching and cool-down period is always recommended.

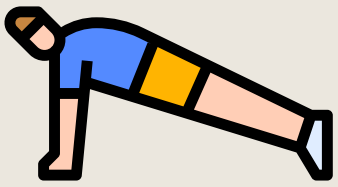
Commander Crunches
Starting position
- Lie on your back, knees bent, feet flat on the floor.
- Chin should be pointed to the sky, arms crossed over your chest.

Procedure
- Using only your abdominal muscles, lift your upper body until your shoulder blades leave the ground. Put one hand on your abdomen to feel your muscles working as you raise your shoulders off the floor.
- Lower your shoulders down using only your abdominal muscles to complete one crunch.
- At your partners command, begin to complete as many crunches as possible in one minute, timed or counted by your partner.

Pilot Plank
Starting position
- Lie down on your stomach.
- Resting on you forearms, make a fist with each hand, place your knuckles on the floor shoulder width apart.
- Using only your arm muscles, push your body off the floor supporting your weight on your forearms and toes.
- Your body should be straight as a board from your head to your feet.

Procedure
- Using the muscles in your abdomen and back, stabilize your body by tightening these muscles.
- Try to keep this position for at least 30 seconds.

Switch places with your partner and follow the same procedure.



Back and abdominal muscles are known as the core muscles. They protect your spine, maintain proper posture, and transfer energy through your body for powerful movements such as swinging and throwing. These muscles work together as you sit up or lie down in bed, turn your body, pick up an object, and stand still. Core muscles also work together to maintain posture while wearing a heavy backpack.

By improving the strength of your core muscles, you will find it easier to stabilize your body, maintain proper posture, and prevent injury. With strong core muscles, you may find that you have better posture, can balance extra weight easier, and you might have better agility for sudden movements during sports activities.

Follow these instructions to train like an astronaut.

https://trainlikeanastronaut.org/

Train Like an Astronaut

Let's get active!

It's a Space fact:
Just like on Earth, astronauts in space must be able to twist, bend, lift, and carry things. They must have strong core muscles so they can perform their tasks efficiently and avoid injury. During missions in space they need to bend their body and hold it straight for extended periods of time. Astronaut's muscles get smaller and weaker over time in a microgravity environment. In order to maintain muscle strength they practice core-building activities before, during, and after their missions. Here on Earth, these activities may include swimming, running, weight training, or floor exercises. In space, they use specialized equipment similar to what you would find here on Earth to keep an exercise routine that will keep their core muscles fit for the job.

Core: The muscles that stabilize, align, and move the trunk of the body; the abdominal and back muscles.

Stabilize: To keep something at the same level; to maintain that level.

Posture: A position the body can assume; standing, sitting, kneeling, or lying down.

Repetition: A motion that is repeated and usually counted.

Forearm: The part of the human arm extends from the elbow down to the wrist; lower arm.

Spine: Consists of the spinal cord, vertebrae and discs; supports an animal's body.

Fitness Accelerations: Test Yourself

- Increase the number of Commander Crunches in one minute.
- Increase the time in which the Commander Crunches and Pilot Plank are performed.
- Repeat the Commander Crunch activity only this time do not cross your arms. While holding the medicine ball over your abdomen, do as many crunches as possible in one minute.
    - Safety: Do not rest the medicine ball on your abdomen. Also, be sure your partner is close by in case you need assistance.
- Repeat the Pilot Plank activity only this time, extend one leg to the side. Hold your leg out for 30 seconds. Repeat this activity with the opposite leg. Alternate extending each leg to the side.
- Try the Mission Specialist Side Heel-Touches as instructed by your teacher.

Think Safety: Astronauts know that it is important to safely strengthen their core muscles in order to protect themselves from injury.

- Breathe normal throughout these physical activities.
- Concentrate on the core muscles when performing each exercise.
- Move carefully until you become acquainted with the movement.
- STOP immediately if you experience any pain or discomfort.
- Avoid uneven surfaces. To avoid injury, perform these activities on a soft but firm surface.

Mission Assignment: Full Body Training

- Explore a jungle gym, placing emphasis on climbing, swinging from a bar, or hanging from a ladder following the rungs to the other side.
- Play a team sport such as kickball or soccer to build core strength.
- Participate in activities that concentrate on core muscles such as yoga, Pilates, gymnastics, and diving.

https://trainlikeanastronaut.org/